upon the uninjured side. Hemisection of the cervical cord stops all contractions upon the operated side, which proves that it is not possible to stimulate the cord in this way. In this connection it will be remembered that Goltz notes the occurrence of epilepsy in dogs from which the cerebrum has been removed, and this without the use of absynth. The most valuable result of Boyce's experiments lies in demonstration of the fact that epilepsy may be looked upon as a reaction of certain centres in the brain to a poison which may pervade the whole system. Its maximal affect is produced, when the cerebral cortex is intact; but centres in the medulla and cerebellum are sufficiently sensitive to be affected. Many cases of epilepsy in man are doubtless due to similar sorts of intoxications, and the fact that the convulsions begin in centres of irritation, *i. e.*, foci of highest sensitiveness, is further support for the generally accepted views. It would seem reasonable, however, that treatment should begin with the toxic substances in the blood rather than with extirpation of sensitive parts of the brain.

A Microscopical Study of the Nerve Cell during Electrical Stimulation. C. F. HODGE. Journal of Morphology, Vol. IX, pp. 449-463, 5 Figs. Boston, 1894.

Changes in Ganglion Cells from Birth to Senile Death; Man and Honey-Bee. C. F. HODGE. Journal of Physiology, Vol. XVII, pp. 129-135, Plate IV. Cambridge, 1894.

Die Nervenzelle bei der Geburt und beim Tode an Alterschwäche. C. F. HODGE. Anatomischer Anzeiger, Band IX, Su. 706-710, 4 Figs.

The first of the above papers forms a new chapter in the nerve-cell-fatigue-work, reports of which have been given in this JOURNAL since 1889. By means of specially devised apparatus the spinal or sympathetic ganglion cells taken from the same frog were kept for different lengths of time in a gentle stream of salt solution upon the stages of two similar microscopes. Comparable cells were sought out in each preparation and electrical stimulation was then applied to the one and not to the other, and drawings, by means of the camera lucida, as well as careful measurements, were made of both preparations at regular intervals. Thirty-three experiments were made in all with the fairly uniform result that the nucleus could be seen to gradually shrink in the cells to which stimulation was applied. This decrease in size may amount to as much as 58% in twenty minutes but never exceeded a loss of 75%. The cell as a whole did not shrink perceptibly, but after treating with osmic acid the stimulated cells could be seen to be pervaded by irregular light spaces, representing probably the vacuoles figured and described in former papers. The greatest shrinkage of the nucleus observed in the control cells was 19%. Experiment 3 continued for six days, during the whole of which time it was possible to distinguish nuclei, nucleoli and the granulation of the cell-protoplasm. Active changes however, in the nucleus ceased to be discernable after six hours. Curves of nerve-cell fatigue obtained by plotting the shrinkage of nuclei differ somewhat from the curves which were formerly derived from cells while in the body. In the latter case the nuclei shrank rapidly at first, then very slowly, or gained a little, and finally decreased in size quite rapidly again to a condition of apparent complete fatigue. When the cells are removed from the body and placed in a non-nutrient solution, as might be expected, no such intermediate recovery occurs. Thus curves derived from measurements of nuclei during stimulation show a much more rapid decline than in case of cells in contact with their normal nutritive supply in the body. They come, in fact, to closely resemble fatigue curves for an excited musle. With a stream of saline solu-

tion continually bathing the cells, it is difficult to conceive that fatigue in this case is to any extent due to accumulation of decomposition products. It was possible also to observe changes in the nucleolus. In general this decreased in size during stimulation, and the reason for this shrinkage could be seen by close observation to lie in the fact that granules were extruded from the nucleolus into the nucleus. If a little potassium tartrate, 0.1% be added to Ringer's solution, the nucleoli in the stimulated cells undergo active, apparently amœboid, changes of form and move about from place to place in the nucleus. They very soon fragment, however, and dissolve. By this method changes resembling those occurring in fatigue can be demonstrated much more quickly than with stimulation of the ganglia while in the living body.

The last paper is an abstract of the second with addition of four figures in the text. The purpose in this investigation is to determine so far as possible the characteristic differences between young and old nerve cells. Especially good material for demonstrating the extreme phases in the process of ageing was supplied by portions of the nervous system from a man dying at the age of ninety-two and of old age apparently uncomplicated by any disease, and to compare with these similar preparations from a male fœtus, killed by accident of birth. The brains of twenty-one old bees were also compared with the same number of young bees' brains. They were in every case caught as they emerged from the brood cell and the old bees were selected by age signs, abraded hairs and frayed wings, etc.

In the cerebrum of the old man no abnormality has been as yet detected by methods thus far employed. The cells appear normal in size and number, so far as this can be determined without special counting, and the nuclei and the nucleoli are in all respects normal. The cells of Purkinje were 25% fewer by count in the cerebellar cortex than in a similar preparation from the cerebellum of a man killed by accident at the age of forty-seven but this difference may be nothing abnormal. Both protoplasm and nucleus of these cells also appear considerably shrunken. The most marked abnormality was found in the cells of the spinal ganglia. Perhaps the most important difference here between young and old cells is a failure of the nucleoli in the old cells to stain with osmic acid. The nuclei, also, in the old cells are considerably shrunken and present irregular outlines and the cell protoplasm is filled with pigment. These differences may be most readily gathered from the following table.

	Volume of nucleus.	Nucleoli observable in nuclei.	Pigment much.	Pigment little.
Fœtus	100%	53%	0%	——
Old Man	64.2%	5%	67%	33%

Nucleoli, comparable to those of vertebrate nerve cells, are not present in the bee's brain, nor is anything resembling the pigment granules of vertebrates to be seen. Aside from these features, however, comparison of young and old bees yields results quite similar to those obtained from human material. The cell protoplasm in the old bees is much vacuolated and the nuclei are shrunken, often almost beyond recognition, In all the young bees the protoplasm is dense and the nuclei are so large in proportion to the size of the cells that they often are pressed into polyhedral forms. In all the sections, one is also impressed by the much greater number of cells in the young brains. An actual count of comparable groups of cells gives one cell in the old to 2.9 cells in the young. Age changes in nerve cells are so marked and in so many respects resemble the changes produced by fatigue that in making experiments on fatigue, the age of animals compared should be taken into account.